Advanced Buildings PEM Fuel Cell System (New FY 2004 Project)

Arne LaVen
Buildings Fuel Cell Program Manager
IdaTech, LLC
63160 Britta Street
Bend, OR 97701
Phone: (541) 322-1038; Fax: (541) 322-1159; E-mail: alaven@idatech.com

DOE Technology Development Manager: Kathi Epping
Phone: (202) 586-7425; Fax: (202) 586-9811; E-mail: Kathi.Epping@ee.doe.gov

Objectives

- Validate and deploy an advanced, integrated 50-kilowatt (kW) proton exchange membrane (PEM) fuel cell system for hotel systems and follow-on applications.
- Develop the fuel cell stack and associated balance of plant by scaling up an existing 25-kW stack design and employing advanced membrane electrode assemblies (MEA).
- Develop the fuel processor and associated balance of plant by scaling up an existing 10-kW equivalent steam reformer and integrating a pressure swing adsorption (PSA) hydrogen purification module for generating hydrogen fuel with purity consistent with a targeted 40,000-hour life system.
- Develop approach for seamless and affordable grid interconnectivity.
- Characterize hotel systems and follow-on market requirements for distributed cogeneration fuel cell systems, and establish a commercialization strategic plan.

Technical Barriers

This project addresses the following technical barriers from the Fuel Cells section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year R,D&D Plan:

Distributed Generation

- E. Durability
- F. Heat Utilization
- H. Startup Time

Fuel Flexible Fuel Processor

- J. Durability
- N. Cost

Components

- O. Stack Material and Manufacturing Cost
- P. Durability

Approach

The overall objective of this project is to develop an advanced 50-kW PEM fuel cell system. The CM-50 power plant will deliver both electricity and thermal energy. It will serve hotel systems initially, and follow-on segments including multi-family dwellings, prison systems, hospital/medical care facilities, office buildings, and similar defense market applications. An Integrated Product Team comprised

of IdaTech, LLC; Hydrogenics Corporation; Southern California Gas; San Diego Gas & Electric; Puget Sound Energy; Marriott International; and the California Hotel & Lodging Association, as supported by W. L. Gore & Associates and R4 Energy, Inc., will perform this work.

An assessment of building systems by the utility partners has revealed that the targeted market segments will effectively use 50 kW of electricity and 65 kW of thermal energy, saving energy costs while reducing environmental emissions. These on-site baseload generators will employ developed and scaled-up fuel cell stack and fuel processing technology, leveraging existing U.S. and Canadian federal investments. The PEM system will reduce baseload electricity and thermal energy expense for mid-sized and large hotel systems through single unit and ganged fuel cell configurations.

The key to the CM-50 fuel cell system solution is a blend of advanced fuel cell technology developed by Hydrogenics, and proven fuel processing technology consisting of steam reforming of natural gas and pressure swing adsorption purification integrated by IdaTech. Hydrogenics will use the latest membrane electronic assembly componentry developed by W. L. Gore & Associates in its low-pressure fuel cell stack. Low pressure is a key to achieving long lifetimes and higher system efficiencies.

Sempra Energy (with members Southern California Gas and San Diego Gas & Electric) and Puget Sound Energy will each site one field trial power plant in their service territories in the 2005 timeframe. Marriott International will select a third field trial site at one of its West Coast properties. The utility and hotel systems will supply grid interconnection solutions as well as manage the overall siting and field trial projects. The California Hotel & Lodging Association will provide guidance regarding hotel systems energy requirements, including buildings integration and expected performance parameters. R4 Energy will provide building and follow-on markets consultation services and recommendations for compliance with federal, state and local buildings codes and standards.

The fuel cell system gross electrical efficiency is projected to be 38% using the DOE definition for efficiency: direct current power at the fuel cell electrodes divided by the total energy of the fuel metered into the fuel cell system based on the lower heating value of natural gas. Overall system efficiency is projected at 71% for installations recovering useful heat down to 50°C. The power and thermal ratings are directly driven by the targeted hotel requirement.

The proposed fuel cell system incorporates the ability to operate in stand-alone uninterrupted power supply mode, displacing for example more than 1,000 emergency diesel gensets deployed in San Diego alone. A diesel genset emits approximately 3 lbs NO_x per megawatt hour (MWh), while the proposed system will emit a virtually undetectable level of NO_x, CO and CO_2. Since sulfur is trapped during fuel processing, fuel cell SO_x emissions will be in the low parts per billion range.

Forty percent of over 13,000 domestic hotel properties could use the forthcoming CM-50 power plant as their source of primary power. The Team will develop the CM-50 fuel cell system, conduct three comprehensive demonstration field trials along West Coast markets from California to Washington state, and proceed to commercial deployments throughout North America.

The Team is committed to deploying the CM-50 commercially at the conclusion of the proposed project. Given the high potential for achieving performance, cost, reliability and durability objectives, early market deployment is achievable. Additionally, applications for a 50-kW system are evolving, indicating a broader market appreciation for their utility.